



EFFECTIVENESS OF MIRROR THERAPY IN IMPROVING MOTOR PERFORMANCE OF UPPER LIMB IN SUB ACUTE HEMIPLEGIC PATIENTS

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ABSTRACT

Objective: This study aimed to investigate the effectiveness of mirror therapy in improving motor performance of upper limb in sub acute hemiplegic patients.

Methods: A quasi experimental study was done with 30 patients divided in the two groups. Patient in group A (control group) & group B (experimental group) were assessed and informed consent were taken. Patients in group A were given task specific exercises along with sham therapy & group B mirror therapy was given along with task specific exercises. Treatment was given for 6 days / week for 4 weeks. Data was collected by means of fugal-meyer assessment for upper limb, motor activity log. Three reading were taken at specific intervals.

Conclusion: Mirror therapy along with task oriented exercises showed significantly greater improvement in motor performance of upper limb in sub acute hemiplegic patients.

INTRODUCTION:

Stroke is the leading cause of disability worldwide, the most common cause of dementia and the third leading cause of death.^[1] It is the leading cause of serious long-term disability in adults. More than 60% of stroke survivors suffer from persistent neurologic deficits that impair activities of daily living.^{[4][5]} Among people who have experienced a stroke 55% to 75% have a paretic arm that causes motor impairment and experience difficulty in incorporating the affected hand into their activities.^{[11][12][13][14]}

Lai and colleagues observed that standard outcome measures of recovery following stroke have consistently underestimated the amount of residual impairments of upper limb after the conclusion of the rehabilitation period.^[12] Within 3 months after stroke onset, only 15% of stroke survivors with upper limb paralysis can expect full, recovery 44% some motor recovery and 40% little or no improvement.^[12] The majority of recovery occurs within the first six months of stroke; although there is some suggestion that for people with chronic stroke, continuing rehabilitation can have functional benefits.^[6]

Various rehabilitative treatments have been introduced to improve the motor control and the functionality of the upper limb, including exercise training of the paretic arm, constraint-induced movement therapy, robotic therapy,¹⁵ functional electric stimulation, proprioceptive neuromuscular facilitation, Brunnstrom, Bobath, electric stimulation exercise, and bilateral arm training.^{[12][15]} Most of the treatment protocols for the paretic upper extremity are labor intensive.^[10]

Task specific exercises is defined as “a training or therapy where patient has to practice context specific motor tasks and receive some form of feedback; with regard to skill learning, it may be associated with different practice conditions, feedback and condition of transfer. The focus is on training of functional tasks rather than impairments.

Post-stroke, there is evidence that task-specific, upper limb training not only impacts functional recovery, but also brain activation patterns. This evidence includes a meta-analysis by Richard et al. (2008) and a review by Carley and Seitz (2007). Examples of upper limb, task-specific training used included: task-oriented motor training (Nelles et al. 2001); CMIT and household tasks. In contrast to most interventions working with sensorimotor training strategies, mirror therapy focuses on visual input. The principle of mirror therapy (MT) is the use of a mirror to create a reflective illusion of an affected limb in order to trick the brain into thinking movement has occurred without pain. It involves placing the affected limb behind a mirror, which is sited so the reflection of the opposing limb appears to place of the hidden limb.

A mirror box is a device which allows the clinician to easily create this illusion. It is a box with one mirror in the centre where on each side of it, the hand are placed in a manner that the affected limb is kept covered always and the unaffected limb is kept on the other side whose reflection can be seen on the mirror.^[28] Mirror therapy has been utilized to improve upper limb function mainly in chronic stroke survivors, while in acute phase only one good quality trial has been published.^[15]

The aim of the present study was to evaluate if mirror therapy, combined with task-oriented exercises can improve motor recovery of the upper limb more than

sham therapy with task-oriented exercises in sub acute stroke patients.

MATERIALS AND METHODS:

A quasi experimental study was done with 30 patients divided equally in the two groups. Group A (control group) and Group B (experimental group) both have 15 patients aged between 45 to 70 years, with first ever stroke. Patient having stroke from 2 months up to 6 months with moderate to mild motor impairment (fugal Meyer assessment 26-56).

And mild to moderate spasticity (modified ashworth scale <2) were included in the study.

PROCEDURE:

A written consent was obtained from all patients who met the inclusion criteria of the study were taken and required assessment of every patient was done.

Total 30 patients were taken which were divided into 2 groups. Group A (control group) and group B (experimental group), both groups were having 15 patients each. In Group A i.e. control group the choice of treatment was task specific exercises along with Sham therapy and in Group B i.e. Experimental group mirror therapy was given along with task specific exercises.

Task specific exercises was given for 6 days per week for 4 weeks (i.e. 24 treatment sessions) for 30 minutes to both the groups. Patients in experimental group (Group B) received mirror therapy for 30 min along with task specific exercises.

Data collected by means of fugal-Meyer assessment for upper limb, motor activity log (quality of movement i.e. QOM).

Three readings were taken one before the treatment, 2nd after 2 weeks i.e. 12th treatment session and 3rd after 4 weeks i.e. after 24th treatment sessions

INTERVENTION TO GROUP A TASK ORIENTED EXERCISES

1. To stimulate shoulder movements (flexion, abduction, extension)-

- Reaching forward to pick up or touch an object.
- Reaching sideways to pick up an object from a table and transferring it to a table in front.
- Grasping and releasing an objects with arm stretched out behind.

2. Stimulate wrist extension and radial deviation- Patient sitting with arm supported on the table, forearm in mid position, fingers and thumb around a glass. The patient attempts to lift the object up.

- Try to lift the glass off the table.
- Try to put it down on the table slowly.

3. To stimulate supination- Fingers around cylindrical object, the patients attempts to supinate the forearm. Try to turn the palm to face upward.

4. **To stimulate palmar abduction and rotation of thumb (opposition)-** Holds the forearm in mid position and wrist in extension, while patient attempts to grasp and release a cylindrical object.
5. **To train opposition of radial and ulnar sides of hand (cupping of the hand)-** Forearm in supination, patients practises opposing thumb and others fingers, particularly fourth and fifth fingers.
6. **To train control over the manipulation of objects-**
 - a. Practice picking up polystyrene cup around the rim without deforming it. Practice by picking it up, holding it while moving the arm and releasing it, do it with his hand close to his body, away from the his body and in conjunction with the other hand.(pouring water from one cup to another).
 - b. Practice picking a piece of paper from his opposite shoulder.

All tasks will be repeat 5 times.

INTERVENTION TO GROUP B

Mirror therapy along with task oriented exercises.

PROCEDURE FOR MIRROR THERAPY

In each session participants receive 30 min of MT followed by 30 min of task oriented functional practice, during the MT training. Patients was seated on a chair, with the mirror board positioned between the upper limbs perpendicular to the subject's midline and with the unaffected upper limb facing the reflective surface. The patients observe the reflection of their unaffected upper limb while performing the following movements:-

- Flexion and extension of the shoulder, elbow, and wrist.
- Pronation and supination of the forearm.
- Radial and ulnar deviation of wrist.
- Finger mass flexion.
- Thumb flexion and adduction.
- Each movements was repeated 50 times.
- 5 min rest interval was given between the mirror therapy session. And 5 min more rest interval was given between the task-oriented exercise session. Total rest interval was 10 min.

After 30 min of MT patients was receive 30 min of task oriented exercises with affected upper limb.

INSTRUMENTATION:

Mirror Box was used. Size of the mirror was 18x24 inches.



DATA ANALYSIS AND RESULTS:

Data was tabulated on master chart. Data analysis was performed using SPSS software version 16.0 Inter group and Intra group comparisons were done. Following tests were used:

Arithmetic mean, unpaired 't' tests were used to determine the significant differences between group A and group B. Repeated measures ANOVA test was used for within group A and B analysis.

Level of significance selected for the study was $p < 0.05$

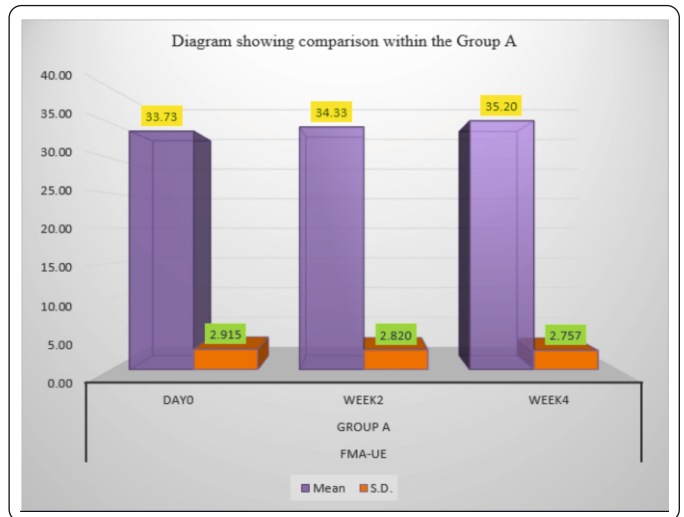


Chart showing comparison of mean and SD of variable FMA-UE Within Group A.

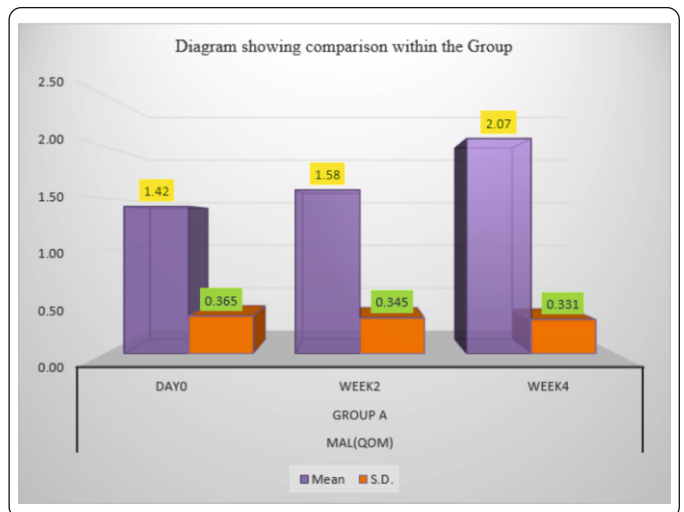


Chart showing comparison of mean and SD of variable MAL (QOM) Within Group A.

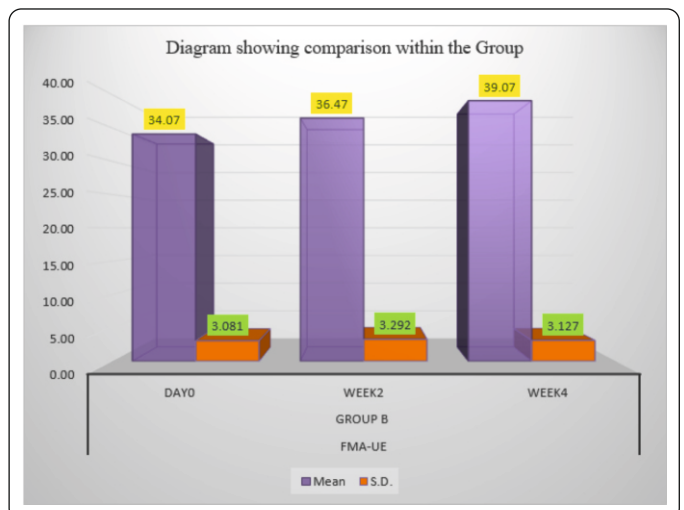


Chart showing comparison of mean and SD of variable FMA-UE Within Group B.

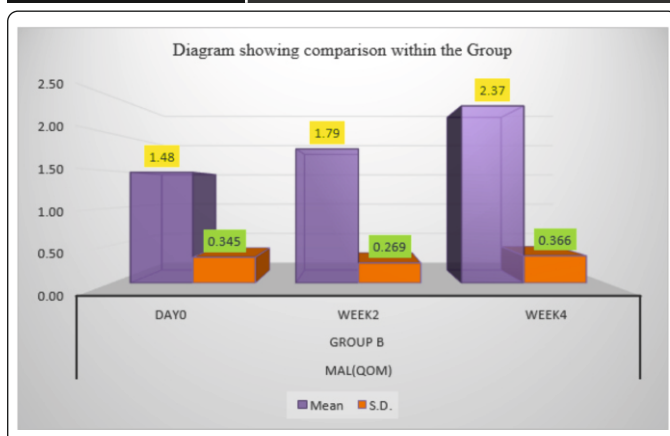


Chart showing comparison of mean and SD of variable MAL (QOM) Within Group B.

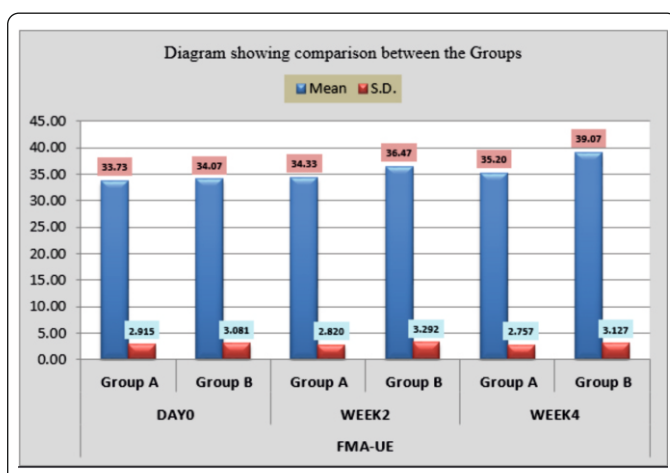


Chart showing comparison of mean and SD of variable FMA-UE between Group A & Group B.

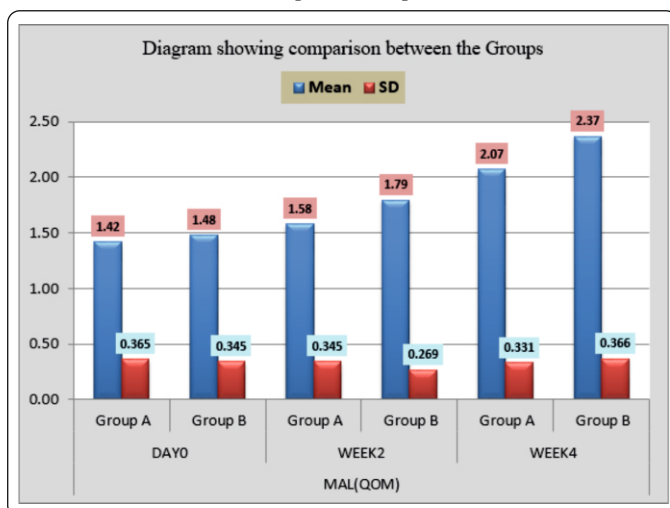


Chart showing comparison of mean and SD of variable MAL (QOM) between Group A & Group B.

On the basis of description of the tables given above showing results of unpaired 't' test to determine the significant differences between Group A & Group B, Repeated measure ANOVA for within group analysis. The result of study showed that both Groups showed significant improvement in fugal-meyer assessment scores (FMA-UE) and motor activity log (quality of movement) MAL (QOM). However when compared both groups, group B i.e. mirror therapy along with task oriented exercises showed significant difference in FMA-UE and MAL (QOM) as compared to Group A i.e. sham therapy along with task oriented exercises.

The analysis showed statistically significant improvement in both groups; however subjects of Group B showed greater improvement in motor performance in upper limb as compared to subjects of Group A.

DISCUSSION:

The result of this study demonstrated that combination of Mirror therapy with task-oriented exercises brings about significant gain in the motor performance in upper limb than Sham therapy & task oriented exercises. The analysis showed statistically significant improvement in both groups; however patients of Group B showed greater improvement in motor performance in upper limb as compared to patients of Group A.

Group A was given task oriented exercises along with Sham therapy for 24 sessions & showed significant improvement in motor performance in upper limb of sub acute hemiplegic patients due to meaningful task oriented practice involving grasp and manipulation important for recovery. Group B, however, was given mirror therapy along with task-oriented exercise for 24 session showed significant improvement in motor performance in upper limb of sub acute hemiplegic patients due to activation of mirror neuron system triggered by the observation of mirror illusion and showed greater improvement in motor performance as compared to Group A.

Improvement in hand function with task oriented exercises can be explained by the fact that these exercises comprises the use of entire upper extremities. These results could be due to improved motor control, functional recovery and increased strength of upper extremity. Task oriented exercises has also been linked to improve cortical reorganization. Jang SH et al. also noted decrease in the unaffected and an increase in the affected primary sensorimotor cortex activities along with the functional recovery in stroke patients who received task oriented exercises. Sung ho Jang et al. suggested that the cortical reorganisation induced by task oriented training in chronic hemiplegic stroke patients. This study demonstrated that 4 week task oriented training can induced functional recovery and cortical reorganization in chronic hemiparetic stroke patients. The main evidence of cortical reorganization was an increase in affected (contralateral) and a decrease in unaffected (ipsilateral) sensorimotor cortex activity.

Based on above mentioned facts we can say that in this study Group A given task oriented exercise along with Sham therapy showed statistically significant improvement in motor performance in upper limb. Group B which was given mirror therapy along with task oriented exercises showed statistically greater improvement in motor performance in upper limb than Group A.

The statistically more improvement in Group B can be explained by combined working mechanisms of task oriented exercises and mirror therapy. Repeated meaningful activities by affected upper limb as in task oriented exercises component might helped to induce cortical reorganization while mirror illusion of unaffected upper limb might have substituted for the decreased proprioceptive feedback. Mirror therapy could provide "proper visual input" and perhaps, "substitutes" for absent or reduced proprioceptive input from the affected body side. Mirror therapy might also facilitate self-awareness and spatial attention by activating the superior temporal gyrus, precuneus, and the posterior cingulate cortex.^[16]

The effect of mirror therapy could be due to the activation of the mirror neuron system, since the observation of movements activates the motor areas in the affected hemisphere, facilitating the excitability of M1 area. However, although superior temporal sulcus is reported to the mirror neuron system, this area has been associated with different behaviours, its exact function remains poorly understood.^[17] Moreover, in the only imaging experiment on inverted visual feedback, lateralized activations were not recorded in the premotor area, but in occipital and posterior parietal regions, assuming that the precuneus region (V6), rather than superior temporal sulcus, plays a decisive role.^[15]

Yavuzer et al, reported that several underlying mechanisms for the effect of mirror therapy on motor recovery after stroke have been proposed.^[11] Altschuler et al, suggested that the mirror illusion of a normal movement of the affected hand may substitute for decrease proprioceptive information, thereby helping to recruiting premotor cortex and assisting rehabilitation through a intimate connection between visual input and premotor areas.

Steven and stoykov et al, suggested that mirror therapy related to motor imagery and that the mirror creates visual feedback of successful performance of the imagined action with the impaired limb.^[2]

As mirror therapy resulted in larger improvements than the control intervention, the mirror does seem to have an additional effect beyond repetitive task oriented training environment and increases somatosensory input, thereby inducing excitability of motor cortex.^[18]

CONCLUSION:

All these facts are responsible for better improvements in motor performance in upper limb in subjects given mirror therapy along with task oriented exercises.

The result of the present study concluded that both group A and B showed statistically significant increase in motor performance of upper limb in sub acute hemiplegic patients. When we compared mirror therapy and task oriented exercises with sham therapy and task oriented exercises. Mirror therapy along with

task oriented exercises showed significantly greater improvement in fugl-meyer assessment score for upper limb (FMA-UE) and motor activity log (quality of movement) MAL (QOM) compared to sham therapy along with task oriented exercises.

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